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(54) **Shock wave lithotripsy apparatus using ultrasonic waves.**

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Description

The present invention relates to a treatment apparatus that converges energy waves, such as ultrasonic waves or shock waves, at one point to treat an object body to be treated (hereinafter referred to as a target section) in the noncontact state.

A shock wave lithotripsy apparatus is one of such apparatuses. In this apparatus, a piezoelectric transducer is driven by a high voltage pulse signal to converge high energy ultrasonic waves from this transducer at one point so as to generate a shock wave. Then, this shock wave is used to disintegrate a calculus, a cancer cell, etc.

FR-A 2 600 521 discloses a full automatic ultrasonic treatment apparatus in which a high-energy ultrasonic wave for destroying a calculus is automatically generated when it is determined that the focal point of the ultrasonic wave coincides with the position of the calculus. There is no manual trigger switch for inputting a trigger instruction for starting the generation of the high-energy ultrasonic wave.

An ultrasonic wave pulse apparatus disclosed in USP 4,617,931 (Dory) is a conventional example of the shock wave lithotripsy apparatus. In this prior art, besides a shock wave generating transducer, an auxiliary transducer for echography is also installed. The shock wave generating transducer is not driven until the focus of the transducer is adjusted on the target section and it is confirmed that the target section coincides with the focus of the transducer using echography.

However, in this apparatus described above, in a case where an operator erroneously operates the switch for generating a shock wave during positioning even when the focus is not properly on the target section, the transducer would be driven so that a generated shock wave could be directed to areas other than the target section. In other words, according to the prior art, pressing the shock wave generating switch always activates and drives the piezoelectric transducer at a high voltage.

Instead of an ultrasonic wave, a discharge in water or an explosive is also used for generating a shock wave.

A hyperthermia apparatus, another treatment apparatus that uses ultrasonic waves, also has a similar problem. The hyperthermia apparatus could use, rather than a high voltage pulse signal, a medium voltage continuous wave signal to activate the transducer.

Accordingly, it is an object of the present invention to provide a noncontact type treatment apparatus which irradiates energy waves which are to be converged at one point to treat a target section using the energy waves in a noncontact

state and prevents erroneous irradiation of the energy waves to start treating the target section even when positioning the converging point of the energy waves on the target section is not completed.

The noncontact type treatment apparatus according to this invention comprises an energy source for generating energy waves which converge at a given point, a treatment unit for driving the energy source at a high voltage to generate the energy waves in response to operation of an operating member to thereby treat an object at the converging point, and a mode selector for setting the operation mode of the treatment unit to a first mode for driving the energy source at a high voltage in response to the operation of the operating member or a second mode for inhibiting a high-voltage driving even upon operation of the operating member.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a perspective view of a shock wave treatment apparatus using ultrasonic waves, as the first embodiment of a noncontact type treatment apparatus according to this invention; Fig. 2 is a block diagram illustrating a control circuit of the first embodiment;

Fig. 3 is a detailed block diagram of a B-mode imaging unit and a lithotripsy unit in the control circuit of Fig. 2;

Fig. 4 is a flowchart illustrating the operation of the first embodiment;

Fig. 5 is a timing chart illustrating the operation of the first embodiment; and

Fig. 6 is a flowchart illustrating the operation of the second embodiment.

Preferred embodiments of a noncontact type treatment apparatus according to this invention will now be described with reference to the accompanying drawings. A description will be given of a treatment apparatus using a shock wave. Fig. 1 is a perspective view illustrating the outline of the first embodiment. Above a bed 10 where a patient (not shown) lies, an applicator 12 is supported by a supporting arm 14 in such a way that it can move in every direction over the patient. Also, it can be tilted around the vertical normal to the patient by a motor (not shown). The applicator 12 is also moved by a motor (not shown) and is positioned at a suitable location with respect to the patient. As will be described later, the applicator 12 comprises ultrasonic transducers which irradiate the ultrasonic waves for treatment, and a water bag which contains water as a medium to transmit the ultrasonic waves from the transducers to the patient.

An operation panel 16 for giving various instructions is provided in front of the applicator 12.

The operation panel 16 includes switches, dials, and keys to input an instruction for movement and rotation of the applicator 12, an instruction for water supply/discharging, an instruction for starting a treatment and various operating parameters. A control unit 18 for performing the whole control is located by the bed 10. A display section 20 is mounted on the top of the control unit 18. The operation panel 16, the transducers of the applicator 12, and the display section 20 are connected to the control unit 18.

Fig. 2 is a block diagram of the control unit 18. The control unit 18 includes a lithotripsy unit 36, a B-mode imaging unit 38, a position controller 40, and a main controller 42 to be connected to the units 36 and 38 and the controller 40. The applicator 12, which is also connected to the units 36 and 38 and the controller 40, comprises a water bag 24 having its top surface made of a curved rigid member, its bottom formed of a flexible film, and its side having a bellows shape. That curved face has such a predetermined curvature that the focus F is set at a specific position on the center axis. A first transducer group 30 is attached on the water bag 24. The transducer group 30 has a number of piezoelectric transducers arranged in a predetermined pattern, which serve to generate ultrasonic waves to be converged on the focus F.

The water bag 24 is filled with water as an ultrasonic wave propagation medium, and its bottom touches a body surface 22 of the patient. The amount of water filled in the bag 24 can be changed by stretching/shrinking of the bellows. The propagation medium is not limited to water but other type may be used as well. The ultrasonic waves converged at the focus F are converted into a shock wave, which is used to disintegrate the target section, such as a calculus and a cancer cell at the position F. The distance between the transducer group 30 and the focus F is always the same. When it is found that a calculus does not coincide with the focus F while viewing a B-mode echography (to be described later), the focus F should be aligned with the calculus by altering the amount of water in the bag 24 by means of pump (not shown) or the like to stretch or shrink the bellows and thus to adjust the distance between the transducer group 30 and the patient's body surface 22.

The water bag 24 has a hole in the center of the upper surface. A rod probe 28 for acquiring an echography for the positioning is inserted in the hole in water-tight manner through a sliding mechanism 26, which includes a motor and an encoder. At the tip of the rod probe 28, a second transducer group 32 having a number of transducers for acquiring a B-mode echography, is disposed. A convex system or sector system or other system can

be used as a scanning system of the transducer group 32. Further, mechanical scanning or electrical scanning may be used as well. The following description will be given with reference to a case where the electric sector scanning system is used. The diameter of the first transducer group 30 should be relatively large due to a large energy needed for the treatment. The diameter of the second transducer group 32 is required to be significantly smaller to avoid interfering the transferring of the ultrasonic waves from the first transducer group 30 for treatment. The probe 28 may be moved up and down with the sliding mechanism 26, based on an instruction from the operation panel 16. This function can always provide an echography at the proximity of the focus F, even if the bellows of the water bag 24 is stretched or shrunk. Also, a marker for indicating the position of the focus F is displayed on the echography according to the distance between the first transducer group 30 and the second transducer group 32. If a calculus is difficult to view, the applicator 12 may be rotated around the axis normal to the patient to change the slice in which an echography will be acquired.

The lithotripsy unit 36 is connected to the first transducer group 30, the B-mode imaging unit 38 is to the second transducers 32, and the position controller is to the sliding mechanism 26. The position controller 40 drives the sliding mechanism 26 to control the rod probe 28 to position the target body in the center of the echography in response to the instruction from the operation panel 16. Outputs from the lithotripsy unit 36 and from the B-mode imaging unit 38 are supplied to the display section 20. The main controller 42 is connected with a positioning/treatment mode selector 44, and a treatment trigger switch 46 which gives an instruction to generate and ultrasonic wave for treatment. The mode selector 44 and the trigger switch 46 may be either installed in the operation panel 16 or constituted by a foot switch.

Fig. 3 shows a detailed block diagram of the B-mode imaging unit 38 and the lithotripsy unit 36. The B-mode imaging unit 38 performs electrical sector-scanning of the applicator 12, especially the second transducer group 32 at the tip of the probe 28, to provide an fan-shaped echography in order to position the focus F of the ultrasonic waves from the first transducer group 30 near the target section.

The B-mode imaging unit 38 includes a multiplexer 51 for switching between transmission and reception of the transducer group 32, a transmitter 52, a pulse generator 53 which produces a low voltage pulse signal (e.g., 100 V, 7.3 KHz) to send the ultrasonic waves from the transducer group 32 at a constant cycle for acquiring a B-mode echog-

raphy, a receiver 54 for receiving an echo signal of the ultrasonic wave, a signal processor 55 for subjecting a received signal to luminance modulation for acquiring an echography, an image memory 56 which stores the echography information generated from the signal processor 55, and an image processor 57 for calculating the brightness of the image around the marker of the echography information stored in the image memory 56 to obtain the degree of focus-calculus matching that will be described later. Ultrasonic reflecting objects, such as calculus and bones, in the echography can increase the brightness of the image.

The lithotripsy unit 36 drives the first transducer group 30 at the top of the water bag 24 with a high voltage pulse signal, to converge the high energy ultrasonic waves on the focus F. The ultrasonic waves are converted into a shock wave due to a non-linear mutual operation between the ultrasonic waves and the medium for transmitting the ultrasonic waves. The shock wave disintegrates a calculus. The lithotripsy unit 36 also drives the first transducer group 30 by a low voltage pulse signal, irradiates a low energy ultrasonic wave on the target section, and receives echo information, such as the waveform of an envelope of the echo signal. In other words, the lithotripsy unit 36 drives the transducer group 30 not only for the lithotripsy operation, but also for an A-mode operation in which the intensity of the echo signal from a calculus is measured. The intensity in the A-mode operation indicates whether there is an ultrasonic reflecting object (calculus) at the focus F, i.e., it corresponds to the degree of focus-calculus matching. The lithotripsy unit 36 comprises a multiplexer 61 for switching between transmission and reception of the first transducer group 30, a transmitter 62, a high voltage pulse (4KV, 500 KHz, for example) generator 63 for sending a high energy ultrasonic wave from the transducer group 30 for disintegration of a calculus, a low voltage pulse generator 64 (50V, 500 KHz, for example) for sending a low energy ultrasonic wave from the transducer group 30 in order to get the A-mode information, a receiver 65 which receives a echo signal of the low energy ultrasonic wave, and a signal analyzer 66 which detects the envelope of the signal received through the receiver 65 to acquire the echo information.

Based on the signals from the mode selector 44 and the trigger switch 46, the main controller 42 sends a trigger pulse signal to the pulse generators 53, 63, and 64, so as to instruct to send the ultrasonic waves.

The operation of the first embodiment will be described referring to the flowchart in Fig. 4. When the apparatus is powered on, and starts operating, the main controller 42 disables the trigger switch

46 from generating a shock wave in step #10. That is, it keeps the trigger switch 46 from being turned on even if it is switched, so that the high voltage pulse generator 63 never receives the high voltage pulse trigger, and the high energy ultrasonic waves can not be generated from the transducer group 30. Therefore, it is possible to prevent malfunction of the trigger switch 46, thereby preventing the normal parts of the patient from being disintegrated.

In step #12, the B-mode trigger pulse with the constant cycle (the flame cycle) starts to be supplied to the pulse generator 53, and the constant cycled ultrasonic waves are sent from the transducer group 32 for acquiring an echography. The echo signal of the ultrasonic wave enters the signal processor 55 so as to provide an echography. Then, the echography is displayed in the display section 20 while the power is on. The main controller 42 displays a marker on the focus F in the echography, based on the distance R between the geometrical center of the first transducer group 30 and the focus F and the distance M between the geometrical center of the first transducer group 30 and the second transducer group 32.

An operator operates the mode selector 44 for setting the positioning mode. The positioning mode can be automatically set after a predetermined period of time from start of operation. Then, if the setting of the positioning mode is detected in step #14, a predetermined low voltage trigger pulse starts to be supplied to the low voltage pulse generator 64, and a low energy ultrasonic wave is sent from the transducer group 30 for the A-mode operation in step #16. The echo signal of the low energy ultrasonic wave is input to the signal analyzer 66 through the multiplexer 61 and the receiver 65. The analyzer 66 detects the envelope of the echo signal and measures the intensity (peak value) of the echo signal. Through this process, it is possible to obtain the degree of focus-calculus matching. A chart of the degree of focus-calculus matching with regard to time is displayed together with the echography on the display section 20. While the apparatus is powered on, the first transducer group 30 is driven for the A-mode operation, and the chart showing the degree of focus-calculus matching is displayed. It is possible to display the degree of focus-calculus matching based on the output from the image processor 57.

Referring to the echography, the marker, and the chart of degree of focus-calculus matching, an operator adjusts the positions of the applicator 12 and the rod probe 28 for focusing the target section such as calculus on the point F.

After focusing, the operator selects a treatment mode with the mode selector 44. When setting the treatment mode is detected in step #18, the opera-

tion of the trigger switch 46 is permitted for generating a shock wave in step #20. In other words, as long as the focus is adjusted and the lithotripsy mode is selected, the shock wave can be driven anytime with the trigger switch 46 on. This process requires not only to turn on the trigger switch 46, but also to select the mode for lithotripsy before generating the shock wave. Then, errors of treating normal parts by erroneously operating the trigger switch 46 can be eliminated. In the treatment mode the position of the applicator 12 is fixed.

The trigger switch 46 is turned on in step #22. In step #24, it is determined whether the degree of focus-calculus matching is above the predetermined level or not, which is based on the intensity of the echo signal measured from the envelop information. When the matching degree is over the predetermined level, one high voltage trigger pulse is supplied to the high voltage pulse generator 63, and the transducer group 30 generates high energy ultrasonic waves. These ultrasonic waves, which are converged on the point F and are converted to a shock wave, are used to disintegrate the target body at the point F, such as a calculus. Therefore, even if the trigger switch 46 is on, a shock wave is not generated without conditions, but it is generated only when the focus-calculus correspondence rate is above the predetermined rate, thus improving the treatment safety. When confirming that the disintegration is completed through the echography, the operator sets off the trigger switch 46. On the other hand, when the disintegration is incomplete, the switch 46 is kept on.

In step #28, it is determined whether or not the trigger switch 46 is off. If the matching degree is not over the predetermined level in step #24, the flow omits step #26, and executes discrimination step #28. When it is detected that the trigger switch 46 is turned off in step #28, the operation is terminated. When it is detected that the switch 46 is turned on in step #28, the flow returns to step #24 for determination of the matching degree.

Fig. 5 illustrates a timing chart of the above-mentioned operation. First, while the power is on, the main controller 42 keeps to supply the B-mode trigger pulse signal to the pulse generator 53. Then, the degree of calculus-focus matching is detected for each frame based on the brightness of the region around the calculus from an echography. The positioning mode is then selected, and the main controller 42 starts sending a low voltage trigger pulse to the pulse generator 64. Then, the calculus-focus matching degree is again detected in accordance with the envelope information of the received echo signal. Finally, in positioning mode, the trigger switch 46 is inhibited from being turned on. In the lithotripsy mode, the main controller 42 supplies a high voltage trigger pulse to the pulse

generator 63, as long as the trigger switch 46 is on and the calculus-focus matching degree is above the predetermined level shown in Fig. 5 by an alternate long and short dash line.

As described above, in the first embodiment there are a positioning mode and a lithotripsy mode as an operation mode. As the positioning mode disables the trigger switch 46 from being turned on to generate a shock wave, it is possible to prevent malfunction-oriented treatment of normal parts. Also, in the positioning mode, the transducer is activated by a low voltage for obtaining the A-mode information and the intensity of the echo signal is detected for the accurate positioning of the transducer. Besides, the lithotripsy safety may be improved by generating a shock wave only when the target is in-focus in the lithotripsy mode.

The second embodiment will be now described. The detailed description of the block diagram of the control circuit is, however, omitted, for the second embodiment has the same structure as the first embodiment. Fig. 6 illustrates a flowchart of operation of the second embodiment. The same process as the first embodiment is taken in the positioning mode. The lithotripsy mode is selected in step #18, and the trigger switch 46 is enabled for turning on in step #20 as per in the first embodiment.

Then, in the second embodiment, in step #32 it is determined whether any instruction to move the applicator 12 is input. The instruction includes an move instruction from the operation panel 16, as well as an instruction for moving the bed 10. When it receives an instruction, the trigger switch is disabled from being turned on in step #34, and the flow returns to step #18. Therefore, when the repositioning of the applicator 12 is necessary in the lithotripsy mode, the positioning mode is automatically taken to prevent a shock wave from being generated. In fact, there are many opportunities that calculus become off focus due to, for example, the patient's movement. The apparatus should often be repositioned in operation (moving the applicator 12 and the bed 10). The other area, besides the target body, will be disintegrated and will hurt the patient when the trigger switch is still on at that time. However, according to this embodiment, entering an positioning instruction enables the trigger switch 46 to be off, and the operation mode to return to the positioning mode. Therefore no accident as mentioned above would occur on the patient, and operations of the apparatus become less complicated.

When it is determined that no movement instruction is received in step #32, it is detected whether the trigger switch 46 is on in the step #22, as per the first embodiment. If it is detected that the degree of focus-calculus matching exceeds the

predetermined level in step #24, one high voltage trigger pulse is generated to the pulse generator 63 in step #26. Then, the transducer group 30 irradiates a high energy ultrasonic waves, so that a shock wave is generated to be used to disintegrate a calculus.

As explained above, in the second embodiment, a movement instruction of the applicator automatically stops the lithotripsy mode and a shock wave generation, and changes the mode to the positioning mode. In other words, when resetting the applicator to focus on a calculus is necessary due to the patient's movement, the lithotripsy mode is automatically set off according to a movement instruction of the applicator. Therefore, it is not necessary to turn off the trigger switch or to operate the mode selector, thus ensuring prompt lithotripsy.

The foregoing description has been given with reference to a shock wave lithotripsy apparatus that uses an ultrasonic wave. This invention can also be applied to noncontact lithotripsy apparatuses other than the one that uses a shock wave; for example, this invention can be applied to a hyperthermia apparatus. The embodiment of this hyperthermia apparatus can be easily realized by replacing the high voltage pulse generator 63 (Fig.3) in the aforementioned embodiment with a medium voltage continuous wave (e.g., 1KV, 500KHz) generator.

As explained above, according to this invention, a noncontact lithotripsy apparatus focuses and irradiates energy waves on the target body for lithotripsy. It has a positioning mode and a lithotripsy mode as an operation mode to be selected by a selector. In the positioning mode, the energy wave for lithotripsy is inhibited from being generated. Therefore, even if the target section is out of focus where the energy waves converge and a trigger switch is erroneously activated, it is possible to prevent treating the normal parts other than the target section. Also, in a case where resetting of the focus of the apparatus is required due to movement of the patient which renders the target section out of focus in the lithotripsy mode, the operation mode automatically returns to the positioning mode when the resetting operation begins. Since it disables energy waves from being generated, it is necessary to perform only the focus resetting operation, and no mode selecting operation is required, thus providing excellent operability.

Claims

1. An ultrasonic treatment apparatus comprising:
 - first ultrasonic generating means (30) for generating ultrasonic waves and for converging the ultrasonic waves on a predetermined point,
 - means (44) for selectively setting an op-

eration mode of said first ultrasonic generating means (30) to either a first mode or a second mode; and

treating means (18) having an operation member (46), which is manually operated by an operator, for instructing a drive of said first ultrasonic generating means (30) at a first level, for driving said first ultrasonic generating means (30) at said first level in response to an operation of said operation member (46) to treat an object at the predetermined point in the first mode, and for inhibiting said first ultrasonic generating means (30) from being driven at said first level even upon the operation of said operation member (46) in the second mode.

2. The apparatus according to claim 1, characterized by further comprising:

means (24) for adjusting a position of said first ultrasonic generating means (30) with respect to an object; and

means (42) for disabling an operation of said operation member (46) when said adjusting means (24) is operated during the first mode.

3. The apparatus according to claim 1, characterized by further comprising:

means (24) for adjusting a position of said first ultrasonic generating means (30) with respect to an object; and

means (42) for changing the operation mode to the second mode when said adjusting means (24) is operated during the first mode.

4. The apparatus according to claim 1, 2 or 3, characterized by further comprising:

second ultrasonic generating means (32) for generating ultrasonic waves for scanning a predetermined plane of the object;

means (38) for obtaining an echography from an echo of said ultrasonic waves generated from said second ultrasonic generating means;

means (55) for detecting an echo obtained of said ultrasonic waves generated from said first ultrasonic generating means when said first ultrasonic generating means is driven by a pulse signal with a second level lower than said first level;

display means (20) for displaying said echography and an output from said echo detecting means; and

means (42) for driving said echography obtaining means, said echo detecting means, and said display means in either said first or second mode.

5. The apparatus according to claim 4, characterized in that said treating means comprises:
 - means (66) for detecting a brightness of a part of the image in said echography which includes the predetermined point; and
 - means (42) for driving said first ultrasonic generating means in response to the operation of said operation member only when said brightness detected by said brightness detecting means is larger than a predetermined value in said first mode.
6. The apparatus according to claim 4, characterized in that said treating means comprises means (42) for driving said first ultrasonic generating means in response to the operation of said operation member only when the output of said echo detecting means is larger than a predetermined value in said first mode.
7. The apparatus according to claim 4, 5 or 6, characterized in that said first ultrasonic generating means (30) comprises a first group of piezoelectric transducers arranged on a curved surface in a predetermined pattern, and said second ultrasonic generating means (32) comprises a second group of piezoelectric transducers arranged substantially at the center and in front of said first group of piezoelectric transducers.
8. The apparatus according to claim 4, 5, 6 or 7, characterized in that said echography obtaining means comprises means for displaying (42) a marker in the echography denoting the predetermined point in accordance with the distance between said first ultrasonic generating means and said second ultrasonic generating means.
9. The apparatus according to claim 2 or 3, characterized in that said adjusting means comprises means for fixing the position of said first ultrasonic generating means in the first mode.
10. The apparatus according to anyone of the preceding claims, characterized in that said treating means (18) comprises means (42) for driving said first ultrasonic generating means with a pulse signal having said first level, whereby treating the object with a shock wave.
11. The apparatus according to anyone of claims 1 to 9, characterized in that said treating means (18) comprises means (42) for driving said first ultrasonic generating means with a continuous wave signal having said first level, whereby treating the object in a hyperthermia manner.

12. The apparatus according to anyone of claims 2 to 11, characterized in that, in the first mode, said adjusting means is enabled and said treating means is disabled, and in the second mode the position of said first ultrasonic generating means with respect to the object is fixed and said treating means is enabled.

Patentansprüche

1. Ultraschallbehandlungsvorrichtung, enthaltend:
 - eine erste Ultraschallerzeugungseinrichtung (30) zum Erzeugen von Ultraschallwellen und zum Konvergieren der Ultraschallwellen auf einen vorbestimmten Punkt,
 - eine Einrichtung (44) zum selektiven Setzen des Arbeitsmodus der ersten Ultraschallerzeugungseinrichtung (30) entweder auf einen ersten Modus oder einen zweiten Modus; und
 - eine Behandlungseinrichtung (18) mit einem Bedienungsteil (46), welcher von einer Bedienungsperson von Hand betätigt wird, zum Anweisen des Betriebs der ersten Ultraschallerzeugungseinrichtung (30) bei einem ersten Niveau, zum Betreiben der ersten Ultraschallerzeugungseinrichtung (30) bei dem ersten Niveau als Reaktion auf eine Betätigung des Bedienungsteils (46), um einen Gegenstand an dem vorbestimmten Punkt im ersten Modus zu behandeln, und zum Verhindern, daß die erste Ultraschallerzeugungseinrichtung (30) bei dem ersten Niveau angetrieben wird, wenn die Betätigung des Bedienungsteiles (46) im zweiten Modus erfolgt.
2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß sie ferner aufweist:
 - eine Einrichtung (24) zum Einstellen der Position der ersten Ultraschallerzeugungseinrichtung (30) in Bezug auf den Gegenstand; und
 - eine Einrichtung (42) zum Unwirksammachen der Betätigung des Bedienungsteils (46), falls die Einstelleinrichtung (24) während dem ersten Modus betätigt wird.
3. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß sie ferner aufweist:
 - eine Einrichtung (24) zum Einstellen der Position der ersten Ultraschallerzeugungseinrichtung (30) in Bezug auf den Gegenstand; und
 - eine Einrichtung (42) zum Wechseln des Arbeitsmodus in den zweiten Modus, falls die Einstelleinrichtung (24) während des ersten Modus betätigt wird.

4. Vorrichtung nach Anspruch 1, 2 oder 3, dadurch **gekennzeichnet**, daß sie ferner aufweist:

eine zweite Ultraschallerzeugungseinrichtung (32) zum Erzeugen von Ultraschallwellen zum Abtasten einer vorbestimmten Ebene des Gegenstandes;

eine Einrichtung (38) zum Erhalten einer Echografie aus einem Echo der Ultraschallwellen, welche von der zweiten Ultraschallerzeugungseinrichtung erzeugt wurden;

eine Einrichtung (55) zum Erfassen eines Echos, welches von den von der ersten Ultraschallerzeugungseinrichtung erzeugten Ultraschallwellen erhalten wurde, wenn die erste Ultraschallerzeugungseinrichtung von einem Impulssignal mit einem zweiten Niveau, welches niedriger ist als das erste Niveau, angetrieben wird;

eine Anzeigeeinrichtung (20) zum Anzeigen der Echografie und des Ausgangssignals der Echoerfassungseinrichtung; und

eine Einrichtung (42) zum Antreiben der Echografieerhaltungseinrichtung, der Echoerfassungseinrichtung und der Anzeigeeinrichtung entweder im ersten oder im zweiten Modus.

5. Vorrichtung nach Anspruch 4, dadurch **gekennzeichnet**, daß die Behandlungseinrichtung aufweist:

eine Einrichtung (66) zum Erfassen der Helligkeit eines Teiles des Bildes in der Echografie, welches den vorbestimmten Punkt beinhaltet; und

eine Einrichtung (42) zum Antreiben der ersten Ultraschallerzeugungseinrichtung als Reaktion auf die Betätigung des Bedienungsteils nur dann, wenn die von der Helligkeitserfassungseinrichtung erfaßte Helligkeit größer als ein vorbestimmter Wert im ersten Modus ist.

6. Vorrichtung nach Anspruch 4, dadurch **gekennzeichnet**, daß die Behandlungseinrichtung eine Einrichtung (42) aufweist zum Betreiben der ersten Ultraschallerzeugungseinrichtung als Reaktion auf die Betätigung des Bedienungsteils nur dann, wenn die Ausgabe der Einrichtung zum Erfassen eines Echos größer als ein vorbestimmter Wert im ersten Modus ist.

7. Vorrichtung nach Anspruch 4, 5 oder 6, dadurch **gekennzeichnet**, daß die erste Ultraschallerzeugungseinrichtung (30) eine erste Gruppe von piezoelektrischen Wandlern, welche nach einem vorbestimmten Muster auf einer gekrümmten Oberfläche angeordnet sind,

aufweist, und die zweite Ultraschallerzeugungseinrichtung (32) eine zweite Gruppe von piezoelektrischen Wandlern aufweist, welche im wesentlichen in der Mitte und vor der ersten Gruppe von piezoelektrischen Wandlern angeordnet sind.

8. Vorrichtung nach Anspruch 4, 5, 6 oder 7, dadurch **gekennzeichnet**, daß die Echografieerhaltungseinrichtung eine Einrichtung (42) aufweist zum Darstellen eines Zeigers in der Echografie, welcher den vorbestimmten Punkt entsprechend der Entfernung zwischen der ersten Ultraschallerzeugungseinrichtung und der zweiten Ultraschallerzeugungseinrichtung anzeigt.

9. Vorrichtung nach Anspruch 2 oder 3, dadurch **gekennzeichnet**, daß die Einstelleinrichtung eine Einrichtung zum Festhalten der Position der ersten Ultraschallerzeugungseinrichtung im ersten Modus aufweist.

10. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß die Behandlungseinrichtung (18) eine Einrichtung (42) aufweist zum Betreiben der ersten Ultraschallerzeugungseinrichtung mit einem Impulssignal bei dem ersten Niveau, wodurch der Gegenstand mit einer Stoßwelle behandelt wird.

11. Vorrichtung nach einem der Ansprüche 1 bis 9, dadurch **gekennzeichnet**, daß die Behandlungseinrichtung (18) eine Einrichtung (42) aufweist zum Betreiben der ersten Ultraschallerzeugungseinrichtung mit einem fortlaufenden Wellensignal bei dem ersten Niveau, wodurch der Gegenstand auf eine hyperthermische Art und Weise behandelt wird.

12. Vorrichtung nach einem der Ansprüche 2 bis 11, dadurch **gekennzeichnet**, daß im ersten Modus die Einstelleinrichtung freigegeben und die Behandlungseinrichtung unwirksam gemacht ist, und im zweiten Modus die Position der ersten Ultraschallerzeugungseinrichtung in Bezug auf den Gegenstand festgelegt und die Behandlungseinrichtung freigegeben ist.

Revendications

1. Dispositif de traitement par ultrasons comprenant :
- un premier moyen de génération d'ultrasons (30) pour la génération d'ondes d'ultrasons et pour la focalisation des ondes d'ultrasons sur un point prédéterminé

- miné;
- un moyen (44) pour établir, de façon sélective, un mode de fonctionnement dudit premier moyen de génération d'ultrasons (30) soit sur un premier mode, soit sur un second mode; et
 - un moyen de traitement (18) possédant une pièce d'opération (46) qui est actionnée, de façon manuelle, par un opérateur pour placer l'activation dudit premier moyen de génération d'ultrasons (30) sur un premier niveau, pour placer ledit premier moyen de génération d'ultrasons (30) sur ledit premier niveau en réponse à un actionnement de ladite pièce d'opération (46) pour traiter un objet sur le point prédéterminé dans le premier mode et pour empêcher ledit premier moyen de génération d'ultrasons (30) d'être activé sur ledit premier niveau même lors de l'actionnement de ladite pièce d'opération (46) dans le second mode.
2. Dispositif selon la revendication 1, caractérisé en ce qu'il comprend, de plus :
- un moyen (24) pour régler une position dudit premier moyen de génération d'ultrasons (30) par rapport à un objet; et
 - un moyen (42) pour désactiver un actionnement de ladite pièce d'opération (46) lorsque ledit moyen de réglage (24) est activé dans le premier mode.
3. Dispositif selon la revendication 1, caractérisé en ce qu'il comprend, de plus :
- un moyen (24) pour régler une position dudit premier moyen de génération d'ultrasons (30) par rapport à un objet; et
 - un moyen (42) pour faire varier le mode de fonctionnement sur le second mode lorsque ledit moyen de réglage (24) est activé dans le premier mode.
4. Dispositif selon la revendication 1, 2 ou 3, caractérisé en ce qu'il comprend de plus :
- un second moyen de génération d'ultrasons (32) pour générer des ondes d'ultrasons pour le balayage d'un plan prédéterminé de l'objet;
 - un moyen (38) pour l'obtention d'une échographie à partir d'un écho desdites ondes d'ultrasons générées par ledit second moyen de génération d'ultrasons;
 - un moyen (55) pour détecter un écho obtenu desdites ondes d'ultrasons générées par ledit premier moyen de génération d'ultrasons lorsque ledit premier
- moyen de génération d'ultrasons est activé par un signal d'impulsion avec un second niveau inférieur audit premier niveau;
- un moyen d'affichage (20) pour l'affichage de ladite échographie et d'une sortie dudit moyen de détection d'échos; et
 - un moyen (42) pour l'activation dudit moyen d'obtention d'échographie, dudit moyen de détection d'échos et dudit moyen d'affichage soit dans ledit premier mode, soit dans ledit second mode.
5. Dispositif selon la revendication 4, caractérisé en ce que ledit moyen de traitement comprend :
- un moyen (66) pour la détection de la brillance d'une partie de l'image dans ladite échographie comprenant le point prédéterminé; et
 - un moyen (42) pour l'activation dudit premier moyen de génération d'ultrasons en réponse à l'actionnement de ladite pièce d'opération seulement lorsque ladite brillance détectée par ledit moyen de détection de brillance est supérieure à une valeur prédéterminée dans ledit premier mode.
6. Dispositif selon la revendication 4, caractérisé en ce que ledit moyen de traitement comprend un moyen (42) pour l'activation dudit premier moyen de génération d'ultrasons en réponse à l'actionnement de ladite pièce d'opération seulement lorsque la sortie dudit moyen de détection d'échos est supérieure à une valeur prédéterminée dans ledit premier mode.
7. Dispositif selon la revendication 4, 5 ou 6, caractérisé en ce que ledit premier moyen de génération d'ultrasons (30) comprend un premier groupe de transducteurs piézo-électriques placés sur une surface gauche selon une configuration prédéterminée et ledit second moyen de génération d'ultrasons (32) comprend un second groupe de transducteurs piézo-électriques placés pratiquement au centre et à l'avant dudit premier groupe de transducteurs piézo-électriques.
8. Dispositif selon la revendication 4, 5, 6 ou 7, caractérisé en ce que ledit moyen d'obtention d'échographie comprend un moyen pour l'affichage (42) d'un repaire dans l'échographie désignant le point prédéterminé selon la distance entre ledit premier moyen de génération d'ultrasons et ledit second moyen de génération d'ultrasons.

9. Dispositif selon la revendication 2 ou 3, caractérisé en ce que ledit moyen de réglage comprend un moyen pour fixer la position dudit premier moyen de génération d'ultrasons dans le premier mode. 5
10. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que ledit moyen de traitement (18) comprend un moyen (42) pour l'activation dudit premier moyen de génération d'ultrasons par un signal d'impulsion dudit premier niveau, traitant ainsi l'objet par une onde de choc. 10
11. Dispositifs selon l'une quelconque des revendications 1 à 9, caractérisé en ce que ledit moyen de traitement (18) comprend un moyen (42) pour l'activation dudit premier moyen de génération d'ultrasons par un signal ondulatoire en continu dudit premier niveau, traitant ainsi l'objet d'une façon hyperthermique. 15 20
12. Dispositif selon l'une quelconque des revendications 2 à 11, caractérisé en ce que dans le premier mode, ledit moyen de réglage est activé et ledit moyen de traitement est désactivé et dans le second mode, la position dudit premier moyen de génération d'ultrasons par rapport à l'objet est fixée et ledit moyen de traitement est activé. 25 30

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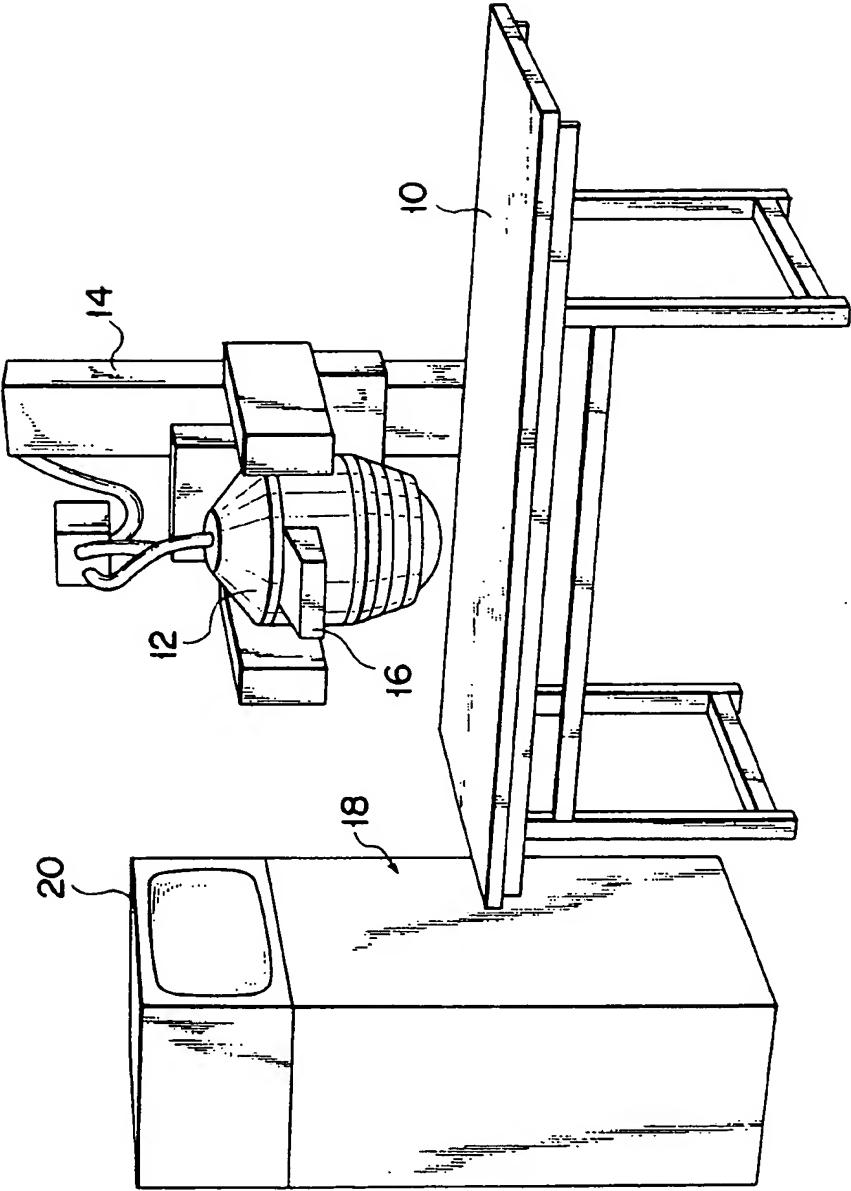
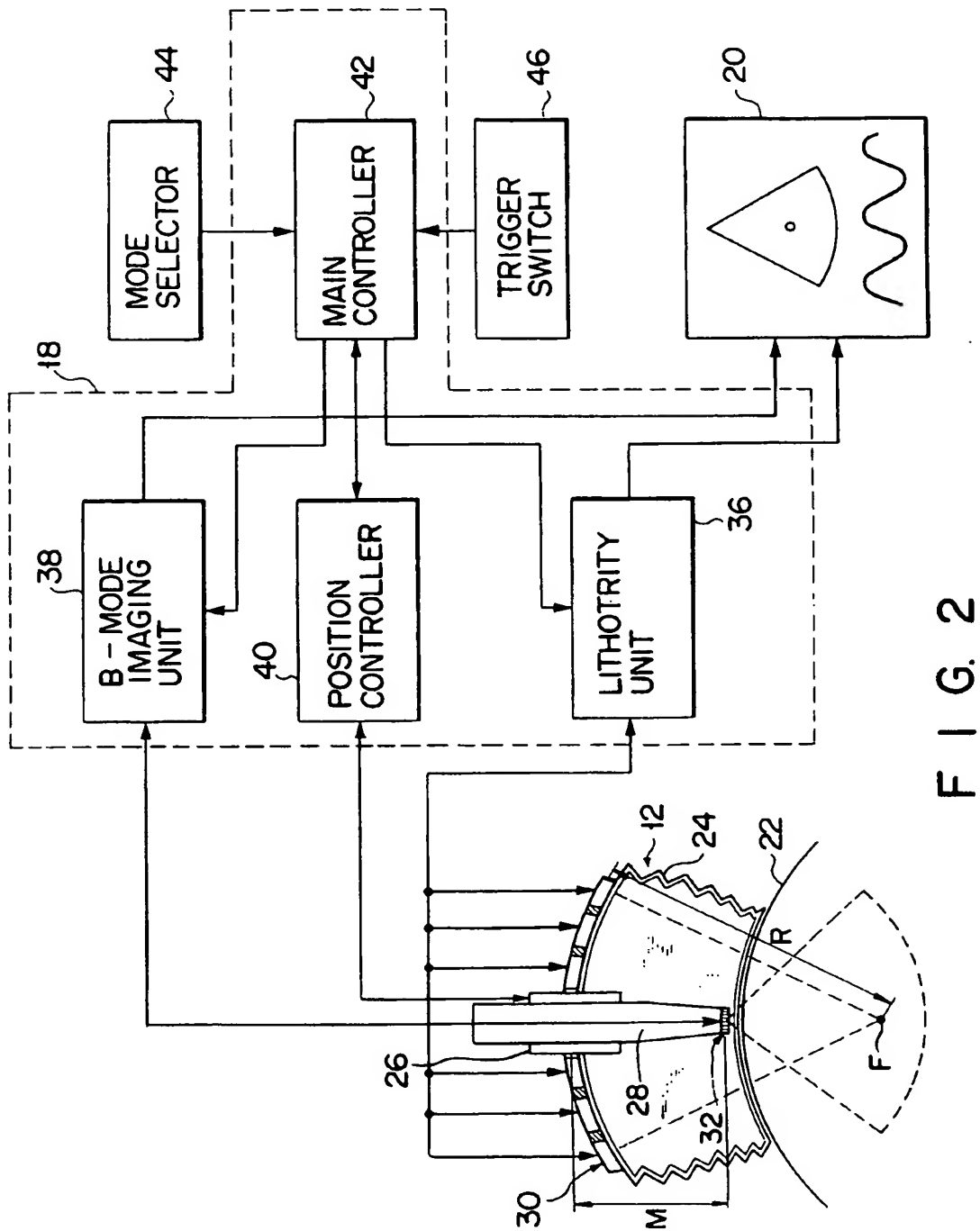
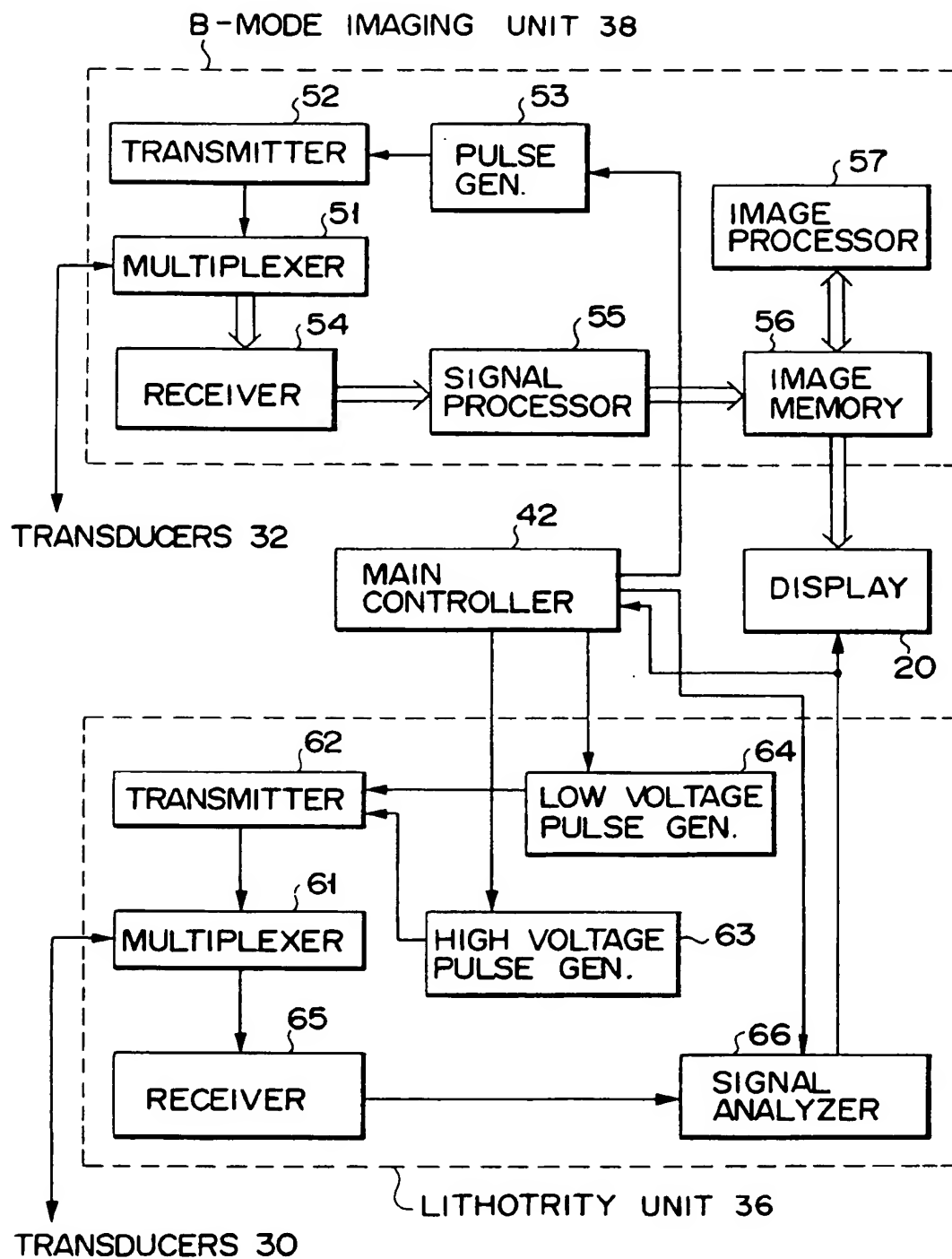


FIG. 1



F-1-G-2



F I G. 3

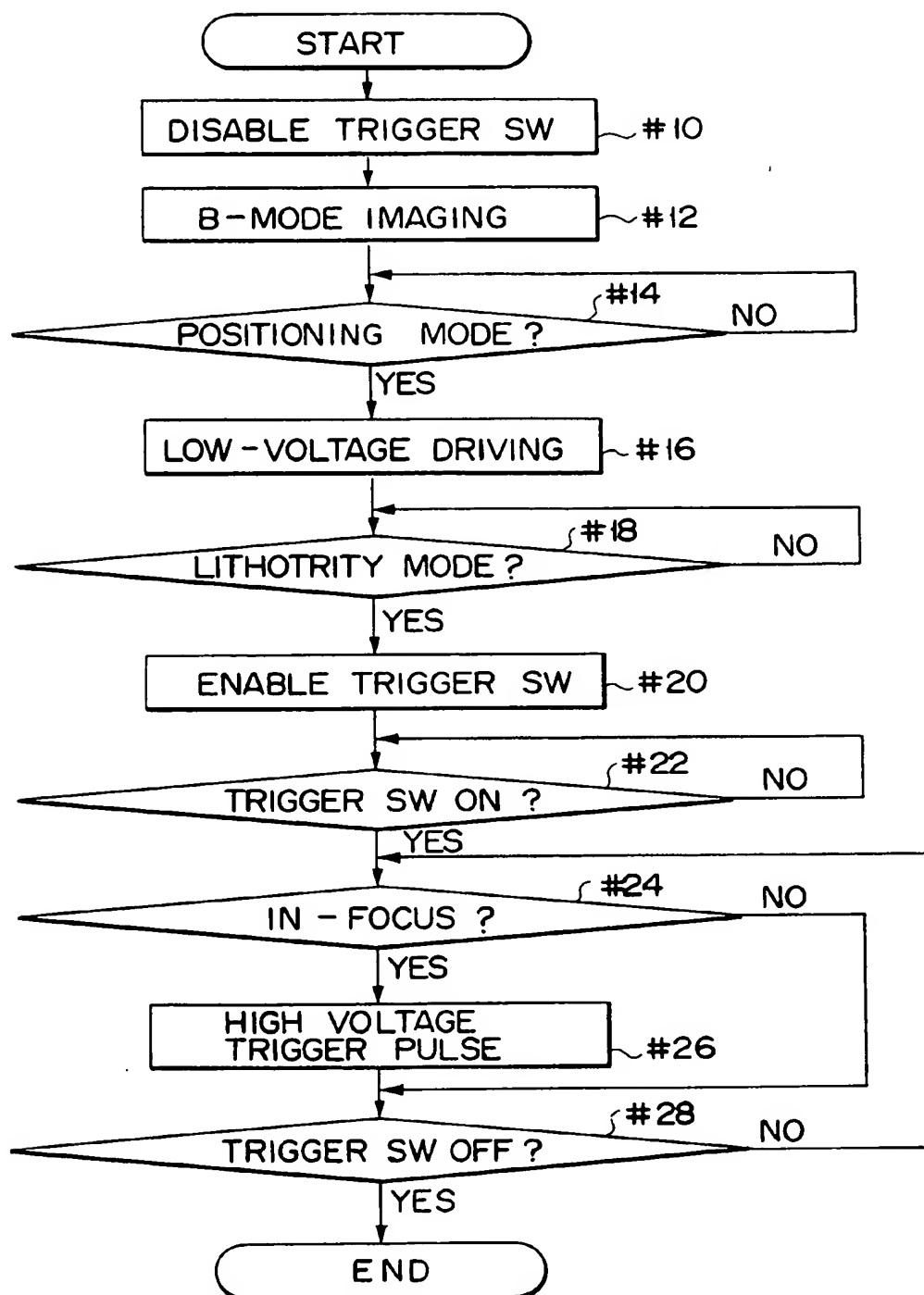


FIG. 4

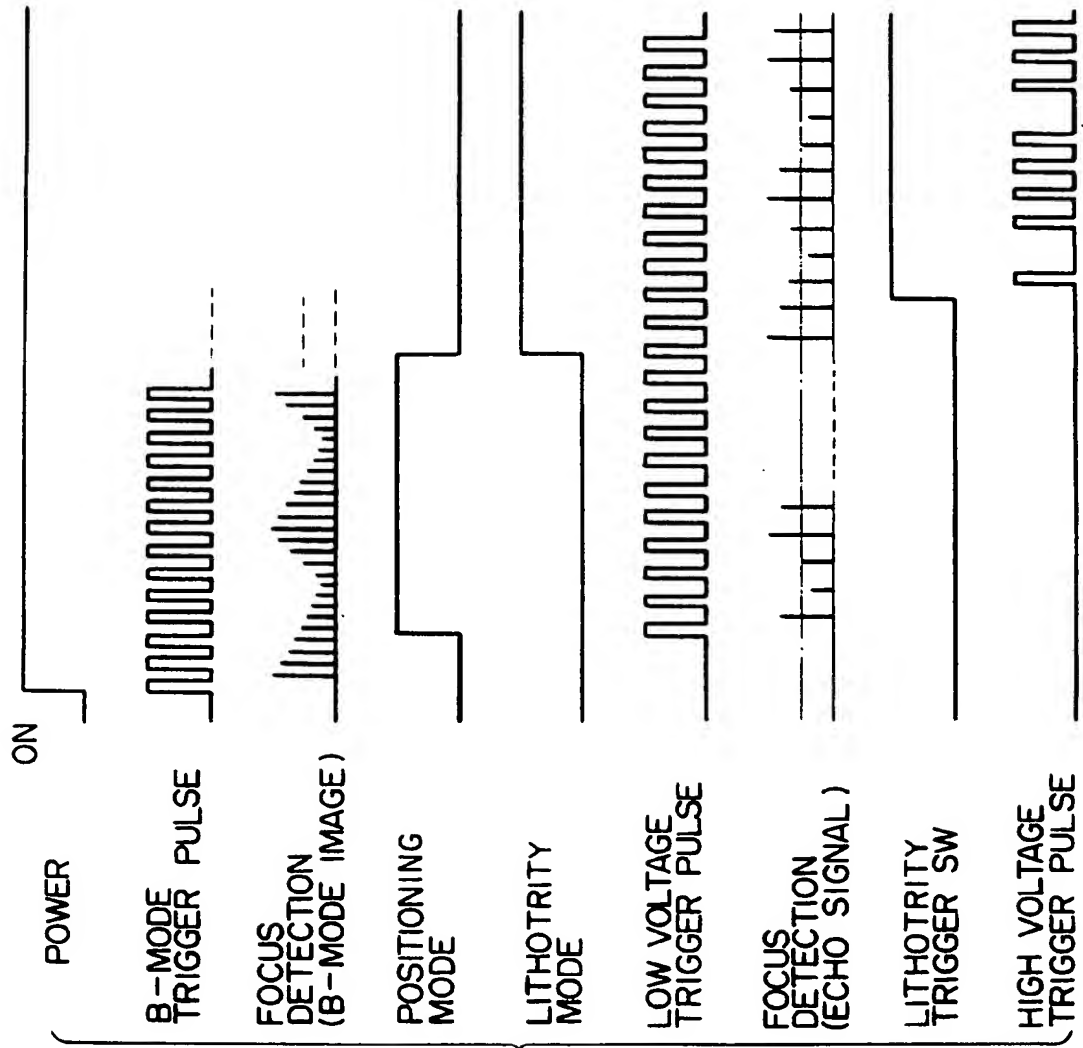


FIG. 5

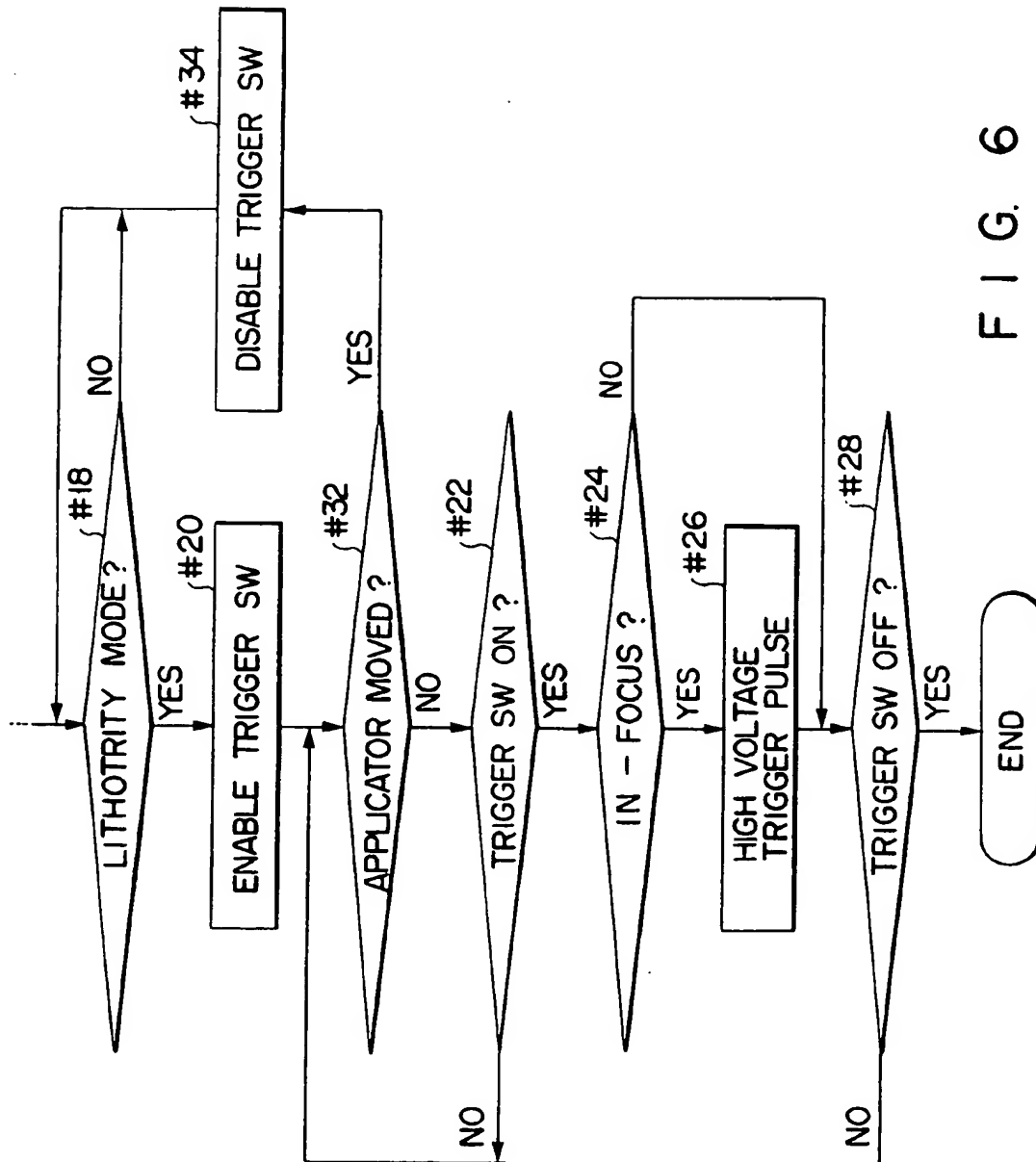


FIG. 6